

HABITAT SELECTION BY BREEDING RED-WINGED BLACKBIRDS

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Habitat selection is a poorly understood aspect of avian behavior. Hilden (1965) proposed that landscape and vegetation initially attract birds to an area; then a detailed examination by the bird determines whether it will be used. The types of environmental stimuli used in habitat selection and their relative importance differ by species.

The Red-winged Blackbird (*Agelaius phoeniceus*) is an economically important species because it is widely distributed, very numerous, and feeds extensively on grain crops. The purpose of this paper is to describe the habitat preferences of breeding Red-winged Blackbirds in an agricultural area.

STUDY AREA AND METHODS

An area of 96.24 km² southeast of Dexter, Washtenaw County, Michigan, was used for the study. This area lies in a glacial plain of low rolling hills with small marshes and woodlots scattered throughout. Soils are primarily loams and clay loams with medium to high productivity. Roads normally follow section lines. The land is intensively cultivated for hay (grass and legumes), corn, wheat, and oats.

During the 1971 breeding season, I counted territorial male Red-winged Blackbirds in 36 randomly selected circular observation areas (100 m radius, 3.14 ha). I located these areas on an aerial photo (1:660), and I categorized them by habitat types (Table 1). I located the territory boundary by mapping the movements of territorial males. Counts were initiated on 1 May 1971 and were repeated at 10-day intervals until late July 1971 (9 time periods).

In 1972-73, I studied 25 observation areas within the 5 habitat types preferred by breeding Red-wings in 1971. Observation areas were randomly selected from the available areas within each habitat type. The limited availability of some habitats caused uneven sample sizes (Table 1). The observation areas were fields and wetlands 1 to 5 ha in size and were chosen independent of the areas used in 1971. Vegetational characteristics were used to describe each observation area and to describe each territory as a separate subunit within the observation area (Table 2; described in more detail by Albers 1975:24). Observations began in mid-March and were repeated at 14-day intervals (10 time periods). I counted females that remained in a male's territory during the observation period as breeding females in 1972-73. Neither males nor females were marked. The selection of observation areas and the observation procedures for males were described in more detail by Albers (1976).

The density of breeding males and females was used as an indicator of their preferences for the habitat types and for the environmental factors characterizing the habitats. Preferences within a habitat type were determined by comparing the measured value of each environmental factor for the habitat type with the measured value

TABLE 1
HABITAT TYPES WITHIN THE OBSERVATION AREAS

Type ^a	Description	Sample Size ^b	
		1972	1973
Old hay	Grass/forb/legume fields cut at least once the previous year	6	7
New hay	Grass/forb/legume crop growing in grain fields of previous year; grain stubble visible in spring	4	2
Pastures	Grass/forb/legume fields grazed by domestic animals	2	2
Old fields	Grass/forb/legume fields not cut or planted for at least 1 year	7	8
Wetlands	Areas too wet for agricultural use	6	6
Cut fields	Grass/forb/legume fields recently cut		
Fallow	Unplowed corn, wheat, oat, and soybean fields harvested the previous autumn but not seeded as in new hay		
Woodlots	Stands of trees > 5 m tall		
Wheat/oats			
Corn			
Soybean			
Edge vegetation	Roadsides, field edges, fencerows, ditches		
Human artifacts/ open water	Roads, homes, barnyards, ponds		
Tilled soil	Bare cultivated soil or fallow land periodically plowed		

^a All of the habitat types listed were present in the 36 observation areas of 1971.

^b Number of observation areas at the beginning of the breeding season 1972-73; agricultural practices reduced the sample size of several of the habitat types during the breeding season. Table 4 shows the total area for each of these 5 habitat types.

of the same factors for the territories within the habitat type. The 20 factors used to describe the habitats (Table 2) were analyzed for each time period by simple linear regressions (SLR), stepwise multiple linear regressions (MLR), and one-way analyses of variance (ANOVA).

The 0.05 level of significance was used for all statistical tests. In the stepwise MLR, independent variables were added to the regression equation if the regression remained significant and if their inclusion improved the coefficient of determination by at least 5%.

TABLE 2
ENVIRONMENTAL FACTORS USED TO DESCRIBE THE OBSERVATION AREAS

Factor	Description
1. Observation area	Size in hectares
2. Males	Number of territorial males
3. Territory size	Size in hectares
4. Females	Number of females on a male's territory
Vegetational composition of a habitat type or territory:	Factors 5–13 classified into 4 categories; absent, 0–25% of vegetative cover, 26–75%, 76–100%. Old and new vegetation were treated separately.
5. Upland grasses	
6. Alfalfa	
7. Clover	
8. Forbs	
9. Crops	Corn, wheat, oats, soybeans
10. Broad-leaved monocots (wetland)	Leaves ≥ 7 mm wide
11. Narrow-leaved monocots (wetland)	Leaves < 7 mm wide
12. Shrubs and trees < 5 m	
13. Trees ≥ 5 m	
Vegetational structure of a habitat type or territory:	Mean of 8 readings for observation areas and mean of 4 for territories.
14.* Effective height	Number of 10-cm sections of a circular wooden rod at least 90% obscured when placed vertically in the vegetation (after Wiens 1969).
15.* Texture	Number of points of contact by vegetation per 10-cm section of a circular wooden rod placed vertically in the vegetation.
16. Height of old vegetation	Height in cm
17. Height of new vegetation	Height in cm
Linear measure of:	
18. Habitat edge	Habitat interface, i.e., field edges
19. Fence rows	Three categories of fence rows; fence only, fence with grass/forb/brush/tree substrate ≥ 1 m wide, previous type with ≥ 1 tree every 25 m.
Presence within a habitat type or territory:	
20. Trees	Three categories of trees; none, shrub/tree < 5 m, tree ≥ 5 m.

* Factors 14 and 15 not used to describe wetland habitat.

HABITAT PREFERENCES

Males.—In 1971, the percentage of the study area represented by a habitat type each time period and the percentage of the total territorial males that were in the same habitat type each time period were compared by paired *t*-test (Table 3). For example, 9 percentages (9 time periods) for the amount of old hay were compared to the 9 respective percentages for the territorial males that were present in old hay. When the *t*-test was significant, the habitat type was considered “preferred” if the mean percentage of territorial males was greater than the mean percentage of occurrence for that habitat type and “avoided” if the percentage of territorial males was less than the mean percentage of occurrence for that habitat type. If the *t*-test was not significant, the habitat type was neither preferred nor avoided. All the paired *t*-tests were significant, therefore Red-wing males preferred old hay, new hay, pastures, old fields, and wetlands; and avoided cut fields, fallow fields, woodlots, wheat/oats, corn, soybeans, edge vegetation, human artifacts/open water, and tilled soil. All habitat types, except wetlands, received similar use during the 3 years. Most of the wetlands in the randomly located observation areas of 1971 were heavily vegetated lowlands rather than marshes with open water.

The initiation dates of territorial activity may vary slightly from year to year because of weather conditions; Fig. 1 shows the average dates for territorial activity during 1972–73. Territorial activity began in wetland and old field habitats during the 3rd week of March, followed by old hay habitat during the 1st week of April and new hay during the 3rd week of April. Livestock delayed territorial activity in pastures; activity began there between late March and late June. Male Red-wings occupied new hay and wetland habitats more rapidly than old hay and old fields. Densities of territorial males were highest 7 weeks after initiation of territorial activity in wetlands and new hay compared with 9–10 weeks in old hay and old fields.

The mean density of territorial males in each of the 5 preferred habitat types was calculated from the May–June period when territorial activity was highest (Table 4). The area within each habitat type and the numbers of breeding birds were changing during this time because of agricultural activity and seasonal changes in breeding activity (Albers 1976). The mean density for wetlands in 1971 was unusually low because most of the wetlands sampled were not of the type used by Red-wings.

Females.—Although males began territorial behavior before the females appeared, females preferred the same habitats in the same sequence as males. The time lag between territorial establishment by males and the appearance of females on territories was at least 4 weeks for pastures, 1–3 weeks for old hay, old fields, and wetlands, and zero for new hay.

TABLE 3

PERCENTAGES OF THE TOTAL STUDY AREA REPRESENTED BY EACH HABITAT TYPE AND
PERCENTAGES OF THE TOTAL TERRITORIAL MALES FOUND WITHIN
EACH HABITAT TYPE—1971

Habitat type*	3 May ^a		12 May		23 May		2 June		12 June	
	Area	Males	Area	Males	Area	Males	Area	Males	Area	Males
Old hay	15.0	28.3	11.8	42.1	11.7	37.4	11.7	36.6	8.0	31.3
New hay	8.2	27.2	7.0	14.8	7.0	19.1	7.0	23.9	5.8	25.4
Pastures	4.2	5.4	4.2	9.7	4.2	9.5	3.9	7.0	3.7	8.7
Cut fields	0	0	0	0	0	0	0	0	3.8	0
Grain	4.8	0	11.4	0	11.4	0	11.4	0	11.4	0
Corn	0	0	0	0	15.1	0	21.0	0	23.7	0
Soybean	0	0	0	0	0	0	0	0	0.2	0
Tilled soil	22.1	0	24.5	9.0	9.1	0	3.8	0	1.7	0.8
Fallow	7.1	0	2.4	0	2.1	0	1.0	0	1.0	0
Old fields	12.3	28.3	12.5	22.8	12.5	24.9	13.1	22.5	13.3	25.1
Wetlands	4.0	10.8	4.0	8.8	4.0	7.3	4.0	8.5	4.0	8.7
Woodlots	14.1	0	14.0	1.8	14.0	1.8	14.0	1.5	14.0	0
Edge	3.1	0	3.1	0	3.8	0	4.0	0	4.2	0
Human artifacts	5.1	0	5.1	0	5.1	0	5.1	0	5.2	0
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Habitat type*	21 June		2 July		10 July		20 July		Mean	
	Area	Males	Area	Males	Area	Males	Area	Males	Area	Males
Old hay	4.7	26.7	2.8	25.0	2.4	28.6	no territorial males		8.5	32.0
New hay	4.1	11.1	1.9	8.3	1.8	14.3			5.4	18.0
Pastures	3.6	5.0	3.3	2.1	4.0	3.6			3.8	6.4
Cut fields	9.5	2.8	14.0	0	14.8	10.7			5.3	1.7
Grain	11.4	0	11.4	0	11.4	0			10.6	0
Corn	23.7	0	23.7	0	23.7	0			16.4	0
Soybean	0.2	0	0.2	0	0.2	0			0.1	0
Tilled soil	1.3	0	1.3	0	1.3	0			8.1	0.1
Fallow	1.0	0	1.0	0	1.0	0			2.1	0
Old fields	13.1	47.7	13.0	52.1	12.0	35.7			12.7	32.4
Wetlands	4.0	6.7	4.0	12.5	4.0	7.1			4.0	8.8
Woodlots	14.0	0	14.0	0	14.0	0			14.0	0.6
Edge	4.2	0	4.2	0	4.2	0			3.9	0
Human artifacts	5.2	0	5.2	0	5.2	0			5.1	0
Total	100.0	100.0	100.0	100.0	100.0	100.0			100.0	100.0

* Middle of time period.

* Comparison of percentages of total area and percentages of total territorial males was made by paired *t*-test; $P \leq .05$. Time periods with values of zero for area were not included in the analysis. The paired *t*-test was significant for every habitat type.

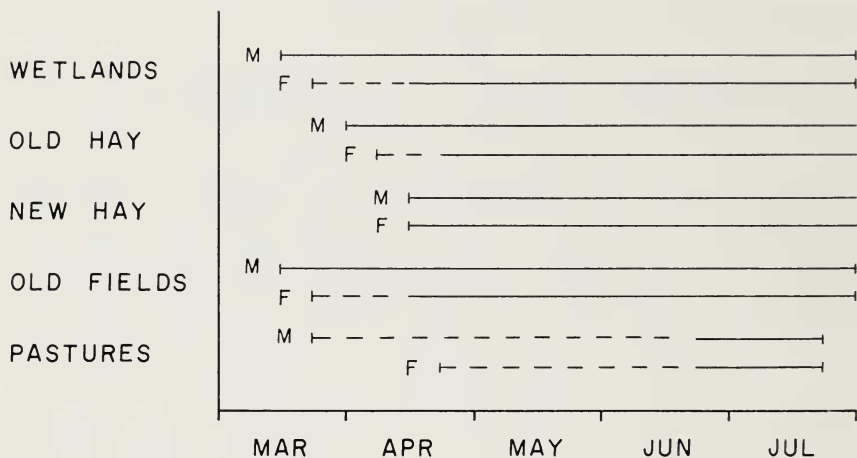


FIG. 1. Periods of territorial activity by male Red-winged Blackbirds and the periods when breeding females were present on the territories. The solid line indicates that territorial males and breeding females were present in both 1972 and 1973; the dotted line indicates they were present during 1 of the years.

Several females in sequence may use a male's territory during the breeding season (Payne 1969:28, Dolbeer 1976). Therefore, the mean density of females during May and June is also only a relative measure of female breeding activity (Table 4). Females are more difficult to observe than are males; this may also have caused an underestimate of female density.

LANDSCAPE AND VEGETATIONAL CHARACTERISTICS

Vegetational composition.—A stepwise MLR analysis of male and female densities in each observation area and the vegetational components (factors 5–13, Table 2) for each habitat type in 1972–73 were inconclusive. A comparison by ANOVA of vegetation (factors 5–11) in territories and observation areas revealed that breeding Red-wings in upland habitat had slight preferences for old and new grasses (*Phleum pratense*, *Dactylis glomerata*, *Poa* spp., *Festuca* spp., *Bromus* spp.) early in the breeding season and new forbs in the middle and late season. In wetland habitat, Red-wings consistently preferred old and new broad-leafed monocotyledons (primarily *Typha* spp., and broad-leafed *Carex* spp.) and consistently rejected old and new narrow-leafed monocotyledons (primarily narrow-leafed *Carex* spp., *Phalaris arundinaceae*, and *Calamagrostis canadensis*) and forbs. A detailed account of the ANOVA and MLR results may be found in Albers (1975:156–165).

Vegetational structure.—In a stepwise MLR analysis of male and female

TABLE 4
NUMBER OF TERRITORIAL MALE AND BREEDING FEMALE RED-WINGED BLACKBIRDS OBSERVED
PER HECTARE IN MAY AND JUNE

Year & (number of time periods)	Habitat type	Area (ha)	Territorial males			Breeding females		
			Males	Males per ha (mean & range)	Mean 71-73	Fe- males	Females per ha (mean & range)	Mean 71-73
1971 (6)	Wetlands	4.5	2- 6	1.05 (0.45-1.11)				
	Old hay	5.4-17.5	8-26	1.66 (0.80-1.99)				
	New hay	4.8- 9.2	3-17	1.53 (0.70-2.29)				
	Old fields	4.4- 4.7	2- 7	0.96 (0.53-1.38)				
	Pastures	13.8-15.0	13-17	0.83 (0.92-1.20)				
1972 (5)	Wetlands	11.2	34-50	3.78 (3.03-4.46)		21-57	3.64 (1.87-4.64)	
	Old hay	7.9-23.2	10-25	1.36 (0.43-2.02)		6-32	1.43 (0.26-2.57)	
	New hay	3.0- 9.6	3-12	0.92 (0.31-1.35)		2-11	1.13 (0.21-1.75)	
	Old fields	16.2	12-17	0.89 (0.73-1.04)		9-20	0.89 (0.55-1.23)	
	Pastures	3.0- 3.9	0	0		0	0	
1973 (4)	Wetlands	11.8	33-46	3.46 (2.80-3.91)	3.62*	25-58	3.53 (2.12-4.93)	3.59
	Old hay	11.2-18.6	25-39	1.96 (1.35-2.02)	1.66	26-44	2.29 (1.99-2.47)	1.86
	New hay	2.9- 6.1	9-11	2.08 (1.47-3.44)	1.51	10-16	2.71 (1.47-4.47)	1.92
	Old fields	17.7	14-18	0.95 (0.79-1.02)	0.93	17-24	1.13 (0.96-1.35)	1.01
	Pastures	3.0- 5.6	1- 5	0.36 (0 -0.89)	0.40	0- 4	0.27 (0 -0.72)	0.14

* The combined mean for wetlands does not include 1971 because most of the wetlands sampled in 1971 were not of the type used by Red-wings.

densities in each observation area and vegetative structure (factors 14-17, Table 2) for the combined upland habitats of 1972-73, height of new vegetation was the factor most frequently included in a significant regression; height of old vegetation and effective height were less often included, and texture was the least often included (Table 5). The inclusions of new vegetation in a significant regression occurred throughout the breeding season but all of the inclusions of old vegetation were before June. For wetland habitat, height of new vegetation was included in a significant regression twice as often as height of old vegetation.

An ANOVA comparing the vegetational structure of observation areas with the vegetational structure of territories for combined upland habitats

TABLE 5
STEPWISE MLR ANALYSIS OF BIRD DENSITY AND VEGETATIONAL STRUCTURE FOR
COMBINED UPLAND HABITATS OF 1972-73

	Old height	New height	Effective height	Texture
Male density	3,0	10,0	2,2	2,1
Female density	4,1*	7,0	4,1	1,0

* Number of times the structural factor was included in a significant regression with bird density. Example indicates 5 instances consisting of 4 positive and 1 negative coefficients. Each factor could have been included in a maximum of 20 significant regressions over the 2 year period (10 time periods per year).

in 1972 showed that breeding Red-wings preferred areas with the tallest and densest vegetation (Table 6). Red-wings did not appear to have any preferences for texture of the vegetation. The 2 significant *F*-tests for old vegetative height occurred early in the breeding season, whereas significant *F*-tests for new vegetative height and effective height occurred throughout the breeding season. These results indicated that breeding Red-wings in upland habitats preferred the tallest old vegetation early in the breeding season, the tallest new vegetation, and the most dense vegetation.

In wetland habitat, the old vegetation was nearly always taller in territories than in observation areas, although the difference in heights was only significant in time period 1 (Table 7). The height of new vegetation was higher in territories than in observation areas during the middle of the breeding season, but none of the differences was significant. Thus, breeding Red-wings in wetland habitat appeared to have a slight preference for the tallest old vegetation.

The ANOVA of vegetational structure for 1973 was very similar to that of 1972 for old and new vegetative height and texture. The effective height of vegetation in territories was always greater than in observation areas but none of the differences was significant.

Habitat edge, fence rows, and trees.—An SLR analysis indicated significant positive correlations between male and female densities and the concentration (m per ha) of habitat edge (factor 18, Table 2) in 1972-73, primarily from March through May. An ANOVA comparing concentration of habitat edge of observation areas with that of territories revealed significantly greater concentrations of habitat edge in territories than in observation areas during March and April (Table 8). Thus, breeding Red-wings preferred areas on the periphery of fields and wetlands early in the breeding season.

A stepwise MLR analysis of the concentration of 3 types of fence rows (factor 19, Table 2) and male and female densities in 1972-73 revealed significant

TABLE 6

ANOVA COMPARING THE VEGETATIONAL STRUCTURE OF OBSERVATION AREAS WITH THAT OF TERRITORIES FOR COMBINED UPLAND HABITATS—1972

Median date time period	Height old vegetation (cm)			Height new vegetation (cm)		
	N ^a	Mean ^b	Sig. ^c	N	Mean	Sig.
21 Mar	16, 1	25.4,41.0	0.51	no vegetation		
1 Apr	19, 9	29.7,53.9	*	18, 9	4.2, 5.0	*
16 Apr	19,22	27.7,47.8	*	19,22	7.7, 11.6	*
1 May	19,25	23.5,35.0	0.12	19,25	15.6, 19.2	0.14
15 May	19,47	23.0,26.1	0.62	19,47	25.6, 30.6	*
29 May	19,52	22.3,24.4	0.72	19,52	55.5, 61.5	0.07
12 Jun	15,46	22.6,27.8	0.48	15,46	74.6, 85.8	*
26 Jun	13,33	24.2,31.4	0.37	13,33	84.0, 97.8	0.06
10 Jul	11,11	26.5,34.8	0.38	11,11	88.5,110.0	*
23 Jul	11, 6	26.2,19.8	0.50	11, 6	82.8,117.8	*

	Effective height			Texture		
	N	Mean	Sig.	N	Mean	Sig.
21 Mar	15, 1	0.24,0.88	0.15	16, 1	0.23, 0.31	0.59
1 Apr	19, 9	0.34,0.85	*	19, 9	0.30, 0.40	0.14
16 Apr	19,22	0.34,0.70	*	19,22	0.29, 0.31	0.76
1 May	19,25	0.61,0.75	0.44	19,25	0.47, 0.58	0.16
15 May	19,47	1.31,1.69	0.07	19,47	0.74, 0.74	0.92
29 May	19,52	3.46,4.03	0.12	19,52	0.73, 0.74	0.80
12 Jun	15,46	3.90,4.92	*	15,46	0.62, 0.60	0.63
26 Jun	13,33	4.19,4.94	0.08	13,33	0.86, 0.57	0.12
10 Jul	11,11	3.66,4.89	0.06	11,11	0.54, 0.48	0.41
23 Jul	11, 6	3.40,5.04	*	11, 6	0.55, 0.55	0.98

^a Number of observation areas, number of territories.^b Mean value for observation areas, mean value for territories.^c Level of significance, F-test; * = $P \leq 0.05$.

negative correlations between bird density and the concentrations of all fence row types, primarily from March through mid-June. The results of ANOVA comparing concentrations of fence rows in observation areas with those of territories were inconclusive. Therefore the influence of fence rows on habitat selection by Red-wings is unclear.

All observation areas either contained trees (factor 20, Table 2) taller than 5 m or had them on the borders. Nearly all territories either contained a tree or the territory owner consistently shared a nearby tree with other territorial males.

TABLE 7
ANOVA COMPARING THE VEGETATIONAL STRUCTURE OF OBSERVATION AREAS WITH
THAT OF TERRITORIES FOR WETLANDS—1972

Median date time period	Height old vegetation (cm)			Height new vegetation (cm)		
	N ^a	Mean ^b	Sig. ^c	N	Mean	Sig.
21 Mar	5, 6	58.0,79.2	*		no vegetation	
1 Apr	4,11	57.5,68.6	0.39		no vegetation	
16 Apr	6,43	63.3,73.3	0.15	3,23	9.3, 9.1	0.92
1 May	6,50	63.3,74.3	0.29	6,50	17.0, 17.7	0.70
15 May	6,47	63.3,74.3	0.28	6,47	33.3, 38.9	0.30
29 May	6,45	61.7,74.2	0.23	6,45	65.8, 72.1	0.43
12 Jun	6,36	55.0,72.2	0.14	6,36	90.0,109.2	0.06
26 Jun	6,34	51.7,65.6	0.18	6,34	113.3,125.3	0.31
10 Jul	6,15	50.0,70.7	0.07	6,15	121.7,135.7	0.12
23 Jul	6, 2	50.0,30.0	0.21	6, 2	130.8,122.5	0.34

^a Number of observation areas, number of territories.

^b Mean values for observation areas, mean value for territories.

^c Level of significance, F-test; * = $P \leq 0.05$.

TERRITORY SIZE

A SLR and a stepwise MLR analysis of territory size and the landscape and vegetational characteristics (factors 5–9, 12–20, Table 2) in 1972–73 indicated that upland territory size was poorly correlated with these factors.

TABLE 8
ANOVA COMPARING THE METERS OF HABITAT EDGE PER HECTARE OF OBSERVATION
AREAS WITH THAT OF TERRITORIES FOR ALL HABITATS COMBINED

Median date time period		Meters of edge per hectare					
		1972			1973		
1972	1973	N ^a	Mean ^b	Sig. ^c	N	Mean	Sig.
21 Mar	14 Mar	22, 8	91.6,158.0	*		no territories	
1 Apr	28 Mar	25,26	94.7,138.0	*	25, 39	91.0,125.7	0.10
16 Apr	12 Apr	25,65	94.7,119.6	0.18	25, 44	91.0,132.1	*
1 May	25 Apr	25,75	94.7,118.9	0.19	25, 73	91.0,113.3	0.20
15 May	9 May	25,94	94.7,111.9	0.40	25,103	91.0, 99.8	0.58
29 May	23 May	25,97	97.2,109.6	0.52	25,110	91.0, 93.7	0.85
12 Jun	6 Jun	21,82	104.8,103.7	0.94	25, 99	94.3, 89.0	0.70
26 Jun	30 Jun	19,67	110.0,108.6	0.94	21, 91	96.4, 79.7	0.27
10 Jul	4 Jul	17,26	112.4,130.1	0.43	19, 44	92.7, 92.7	0.99
23 Jul	18 Jul	17, 8	112.4,128.2	0.65	17, 13	100.0, 91.2	0.63

^a Number of observation areas, number of territories.

^b Mean value for observation areas, mean value for territories.

^c Level of significance, F-test; * = $P \leq 0.05$.

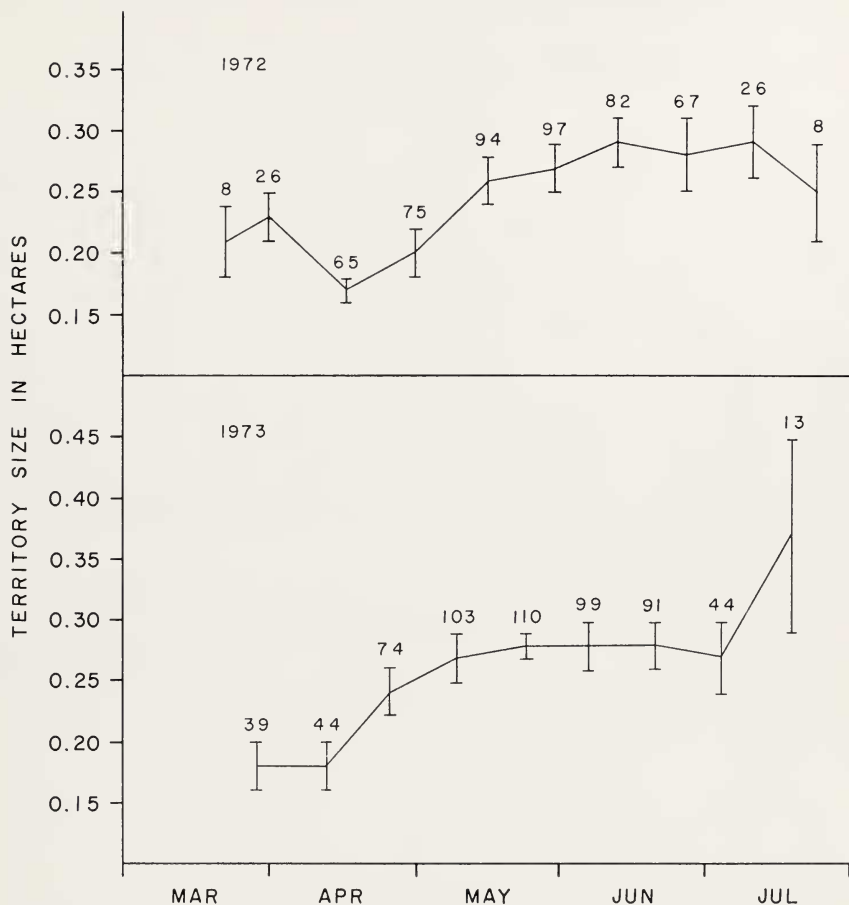


FIG. 2. Size of male territories for all habitat types combined. Vertical brackets represent 1 standard error of the mean. The number of territories is shown above each bracket.

However, wetland territories (1) decreased in size as the proportion of broad-leaved monocots increased and as the general vegetative height increased, and (2) increased in size as the proportion of narrow-leaved monocots increased and as the general vegetative height decreased.

Territory size for the combined habitats began to increase about early May and continued until mid-June when the average territory was between 25 and 50% larger than during March (Fig. 2). The mean sizes of upland territories were usually 1.5–2.0 times larger than the mean size of wetland territories (Table 9).

TABLE 9
SIZE (HECTARES) OF MALE RED-WING TERRITORIES FOR 1972-73

Median date time period		1972-73									
		Wetlands		Old hay		New hay		Old fields		Pastures	
1972	1973	N	Mean	N	Mean	N	Mean	N	Mean	N	Mean
21 Mar	14 Mar	7	0.21	a		a		1	0.24	a	
1 Apr	28 Mar	46	0.17	2	0.29	a		15	0.25	2	0.25
16 Apr	12 Apr	80	0.15	8	0.17	a		19	0.27	2	0.40
1 May	25 Apr	91	0.15	26	0.37	8	0.32	23	0.28	1	0.32
15 May	9 May	93	0.16	52	0.40	18	0.35	33	0.29	1	0.32
29 May	23 May	89	0.15	64	0.36	23	0.34	29	0.34	2	0.37
12 Jun	6 Jun	76	0.19	55	0.35	16	0.43	34	0.34	a	
26 Jun	20 Jun	67	0.20	41	0.30	13	0.35	32	0.36	5	0.37
10 Jul	4 Jul	38	0.22	14	0.35	a		17	0.36	1	0.19
23 Jul	18 Jul	8	0.19	5	0.26	a		7	0.54	1	0.19

^a No territories.

RESPONSE TO HABITAT ALTERATION

Hay was cut between 27 May and 5 June during 1971-73. Breeding Red-wings seldom remained in their territory more than 48 h after it was cut. Red-wings did not establish territories or attempt to nest in cut fields after the vegetation grew back. The effect of hay cutting on the densities of males and females was determined by separating the habitats subject to harvest (old and new hay) from those not subject to harvest (pastures, old fields, and wetlands). Changes in male and female density were compared with the proportion of hay harvested (Fig. 3). Two relationships were apparent:

(1) Densities of males and females peaked in uncut hayfields after a large amount of hay in other fields was cut. For 4 weeks after hay cutting began, 10-60% more females were in uncut hayfields than were present before hay cutting. After the 3rd week of June, the number of females in uncut hayfields decreased more rapidly than the hay was being cut. Changes in the densities of males during 1971-73 did not appear to be related to the cutting of hay, however.

(2) Male and female densities in habitats not subject to cutting peaked at least 4 weeks before hay cutting began and continued to decrease during the hay harvest.

The response of breeding females to hay cutting suggests that many of the displaced females attempted to relocate their breeding effort, and that they were reluctant to use a different habitat type.

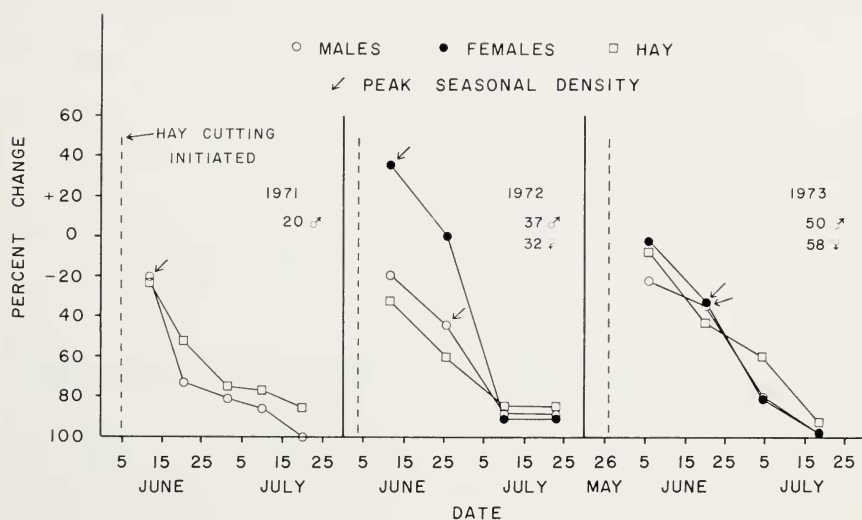


FIG. 3. Percentage change in numbers of male and female Red-wings in old and new hayfields and in the amount of unharvested hay from the time period before the onset of hay cutting. Numbers of males and females present prior to hay cutting are indicated below each year.

DISCUSSION

Red-winged Blackbirds in agricultural areas seem to have strong preferences for certain habitat types during the breeding season. Preferred habitats with the greatest amount of old vegetation (old fields and wetlands) are occupied early in the breeding season. Occupation of preferred habitats with inadequate vegetation is delayed until enough new vegetative growth appears (old hayfields, new hayfields, and pastures). Preferred habitat not in existence the previous year is occupied last (new hayfields). When new hayfields are finally used they are occupied very rapidly; presumably by adults without breeding sites and unsuccessful territorial males (Martin 1971:113-116, Bobolink [*Dolichonyx oryzivorus*] study). The selection of a particular habitat type by Red-wings may be due to site and habitat fidelity (Beer and Tibbitts 1950, Nero 1956, Fankhauser 1964, Laux 1970:33-46), an ability to evaluate the quality of available areas, or a combination of fidelity and evaluation. The apparent reluctance of female Red-wings to change habitat for renesting after their hayfield habitat was cut suggests that habitat fidelity of females is very strong after the breeding effort has begun. I did not have marked females in my study, but Jackson (1971:51) reported that 21 of 25

marked females in marsh habitat renested in marshes after their nests were destroyed.

The early season preferences by Red-wings for old grasses in uplands and old broad-leafed monocots in wetlands indicate the importance of erect residual vegetation. Upland grasses and the broad-leafed monocots of wetlands are partially upright and easily visible in early spring, whereas clover, the narrow-leafed monocots of wetlands, and most forbs are not. Old alfalfa (*Medicago sativa*) was also partially upright in the early spring but it was not preferred as consistently as old grass. The initial territorial activity in the spring was early when the amount of residual vegetation was large. Structural strength of vegetation also appears to be important for nesting because female Red-wings preferred broad-leafed monocots in wetlands throughout the breeding season and new upland forbs in middle and late season.

Breeding Red-wings are attracted to tall vegetation and vegetation that restricts visibility. The height of old vegetation was important to Red-wings only in April and May. Height of new vegetation was important during the entire breeding season. Vegetation that restricted visibility was important to upland nesters, but the number of plant stems and leaves per unit area (texture) was not important by itself. Zimmerman (1971) found that male Dickcissels (*Spiza americana*) also preferred tall vegetation and vegetation that restricted visibility for their territories.

As the breeding season progresses, the relationship between breeding Red-wings and vegetation becomes less clear. Not only does vegetation change, but the gradual increase in the number of males and females (Albers 1976) indicates that territories in less preferred areas are probably being established (Svardson 1949, Zimmerman 1971). Weins (1973) reported similar temporal declines in the vegetational differences between territories and non-territorial areas for Grasshopper Sparrows (*Ammodramus savannarum*) and Savannah Sparrows (*Passerculus sandwichensis*).

If the intensity of competition among males reflects the quality of habitats, then territories in better quality habitat would be smaller as a result of the greater effort required to defend them (Fretwell 1972:104). The difference in Red-wing territory size between wetland habitat and upland habitats implies that old and new hay, old fields, and pastures are either of lower quality or are used differently than wetlands. Differences in use might occur in territorial defense, foraging, and nesting activities. Although general habitat types (upland, wetland) affect territory size, specific vegetational and landscape characteristics only appear to affect territory size in wetlands.

Several factors could account for territorial expansion in middle and late season; (1) the early use of preferred areas restricts later breeding activity

to undesirable areas, hence decreased competition and larger territories, and (2) the abandonment of territories permits neighboring males to expand their territories (Novy 1973). Seasonal changes in territory size have also been reported for other grassland bird species (Wiens 1969, Martin 1971:79, Thompson and Nolan 1973, Wiens 1973, Welsh 1976).

An evaluation of habitat selection by a species with a long breeding season, such as the Red-winged Blackbird, is more meaningful if it is performed throughout the breeding season. The detectability of preferences, and perhaps the preferences themselves, may change markedly.

SUMMARY

Habitat preferences of breeding Red-winged Blackbirds in an agricultural area were determined by comparing population density, landscape characteristics, and vegetational descriptions. Observations were made throughout the breeding season. Preferred breeding habitats of Red-wings, in order of preference, were wetlands, hayfields, old fields, and pastures. Males and females occupied old fields and wetlands first, then hayfields, and finally, pastures.

Cutting of hayfields caused territorial abandonment by both sexes within 48 h. The apparent movement of displaced females from cut hayfields to uncut hayfields suggests that habitat fidelity of females is strong after the breeding effort has begun.

Breeding Red-wings exhibited general preferences for trees, large amounts of habitat edge, erect old vegetation, and sturdy, tall, and dense vegetation. Vegetative forms and species, such as upland grasses, broad- and narrow-leaved monocots in wetlands, and forbs were important to the Red-wing at various times during the breeding season. Landscape and vegetational preferences of breeding adults were easier to observe early in the breeding season (March through May) than later. Vegetational growth and increases in the size of the breeding population probably make these preferences more difficult to detect.

Territory size was poorly correlated with landscape and vegetational characteristics in uplands but strongly correlated with broad- and narrow-leaved monocots and vegetative height in wetlands. Wetland territories were smaller than upland territories. Territories increased in size during the middle and late portions of the breeding season. Habitat selection by the Red-winged Blackbird can best be studied by evaluating vegetative preferences throughout the breeding season.

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